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EXAMINER

GOLDEN, JAMES R

ART UNIT PAPER NUMBER

2187

DATE MAILED: 03/24/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|--------------------------------------|--------------------------------------|--|
| Office Action Summary | Application No. 10/674,942 | Applicant(s) MARTIN ET AL. | |
| | Examiner James Golden | Art Unit 2187 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 September 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-42 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-42 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>10/20/03</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

The instant application 10/674942 has a total of 42 claims pending. There are 3 independent claims and 39 dependent claims.

Information Disclosure Statement

1. The information disclosure statement submitted on 10/20/2003 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.
2. Several references have been struck through on the IDS because they are non-patent literature documents that have not been provided.

Priority

3. The examiner recognizes and accepts the applicants' claim for priority to 03/21/2003 based on provisional application 60/456786.

Drawings

4. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: 104, 106, 107, 108, 110, 112, 113, 114 and 116 of Fig. 1; all elements of Figs. 2A-2D except 200 and 210; all elements of Figs. 3A-3B; 904 of Fig. 9; and 1004 of Fig. 10.
5. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application.

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Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

6. **Claims 4-5, 18-19 and 32-33** are objected to because of the following informalities: claims 4, 18 and 32 recite the limitation "wherein deleting the data node from the linked list additionally involves..." in lines 1-2. There is insufficient antecedent basis for this limitation in the claim. Claims 5, 19 and 33 are objected to because of their respective dependencies on claims 4, 18 and 32. These objections could be overcome by changing claims 4, 18 and 32 to respectively depend from claims 3, 17 and 31.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. **Claims 1-3, 15-17 and 29-31** are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael ("High Performance Dynamic Lock-Free Hash Tables and List-Based Sets") in view of applicants' disclosed prior art.

9. **With respect to claims 1, 15 and 29**, Michael discloses a method (which can also be implemented in a computer-readable storage medium, or by an apparatus) for using a hash table that is fully dynamic and lock-free (page 73, column 2, paragraph 7, "This paper presents..."), comprising:

- performing a lookup into the hash table, wherein the lookup involves,
 - using a hash key to lookup a bucket pointer in a bucket array (page 74, column 1, paragraph 5, lines 3-8, "The most common method..."),
 - following the bucket pointer to a data node within a linked list (page 74, column 1, paragraph 5, lines 3-8, "The most common method..."; page 77, column 2, paragraph 5, "A thread keeps..."),
 - and

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- searching from the data node through the linked list to locate a node that matches the hash key if one exists (page 77, column 2, paragraph 5, "A thread keeps...");
- wherein the linked list contains only data nodes and at most a constant number of dummy nodes (page 74, Fig. 1 shows only data nodes; page 74, column 1, paragraph 10, "Figure 1 shows...").

Michael does not disclose the limitation wherein the linked list contains all of the data nodes in the hash table.

However, applicants' disclosed prior art disclose the limitation wherein the linked list contains all of the data nodes in the hash table (Fig. 2A; specification, page 4, lines 3-6).

Michael and applicants' disclosed prior art are analogous art because they are from the same field of endeavor, namely hash table design.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the single linked list that contains all the data nodes of the hash table of the applicants' disclosed prior art with the hash table of Michael.

The motivation for doing so would have been because having a single linked list that contains all of the data nodes prevents the data nodes from "needing to be moved when the number of hash buckets changes" (applicants' specification, page 4, lines 5-6).

Therefore, it would have been obvious to a person of ordinary skill in the art to combine the applicants' disclosed prior art with Michael for the benefit of a

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hash table with a single linked list that contains all the data nodes of a hash table to obtain the invention as specified in claims 1, 15 and 29.

10. **With respect to claims 2, 16 and 30**, Michael in view of the applicants' disclosed prior art disclose the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 1, 15 and 29 (see above paragraph 9). Michael further discloses the limitation wherein the data node pointed to by the bucket pointer precedes the nodes in the bucket (Fig. 1; page 74, column 1, paragraph 10).

11. **With respect to claims 3, 17 and 31**, Michael in view of the applicants' disclosed prior art disclose the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 1, 15 and 29 (see above paragraph 9). Michael further discloses the limitation wherein deleting the data node from the linked list involves:

- using an atomic operation to mark the data node as dead (page 76, column 2, paragraph 6, lines 3-5, "If the key is found..."); and
- atomically updating the next pointer of the predecessor of the data node to point around the data node to the successor of the data node in the linked list (Fig. 6; page 76, column 2, paragraph 6, "A Delete operation...").

12. **Claims 4, 18 and 32** are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael ("High Performance Dynamic Lock-Free Hash Tables and List-Based Sets") in view of applicants' disclosed prior art as applied to claims 1-3, 15-17 and 29-31 above, and further in view of Rakity et al. (US 5,671,446).

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13. **With respect to claims 4, 18 and 32**, Michael in view of the applicants' disclosed prior art disclose the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 2, 16 and 30 (see above paragraph 10). Michael in view of the applicants' disclosed prior art does not disclose the limitation wherein deleting the data node from the linked list additionally involves redirecting the next pointer of the data node to become a back pointer that points to the predecessor of the data node.

However, Rakity et al. disclose the limitation deleting the data node from the linked list additionally involves redirecting the next pointer of the data node to become a back pointer that points to the predecessor of the data node (Fig. 8; column 12, lines 46-51).

Michael, applicants' disclosed prior art and Rakity et al. are analogous art because they are from the same field of endeavor, namely linked list arrangement.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the pointer reversal of Rakity et al. with the hash table of Michael and the applicants' disclosed prior art.

The motivation for doing so would have been so that "the entire LIFO linked list 44 does not have to be scanned every time an element is to be dequeued" (column 12, lines 49-51).

Therefore, it would have been obvious to a person of ordinary skill in the art to combine the Hills with Michael and the applicants' disclosed prior art for the

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benefit of a hash table that uses garbage collection to obtain the invention as specified in claims 4, 18 and 32.

14. **Claims 5, 19 and 33** are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael ("High Performance Dynamic Lock-Free Hash Tables and List-Based Sets") in view of applicants' disclosed prior art and Rakity et al. (US 5,671,446) as applied to claims 4, 18 and 32 above, and further in view of Schimmel (US 5,960,434).

15. **With respect to claims 5, 19 and 33**, Michael in view of the applicants' disclosed prior art and Rakity et al. disclose the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 4, 18 and 32 (see above paragraph 21). Michael in view of the applicants' disclosed prior art and Rakity et al. do not disclose the limitations wherein if a search through a chain of nodes from the back pointer does not lead to a live node, the method further comprises:

- obtaining a parent bucket pointer for the bucket pointer;
- searching through the linked list from a node pointed to by the parent bucket pointer to locate a starting node for the bucket pointer; and
- updating the bucket pointer to point to the starting node.

However, Schimmel discloses the limitations if a search through a chain of nodes from the back pointer does not lead to a live node (column 8, lines 13-14, if the bucket contains a regular pointer), the method further comprises:

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- obtaining a parent bucket pointer for the bucket pointer (column 8, lines 11-16; “if a bucket... includes a logical back pointer,” lines 13-14, indicates that the bucket pointer is being initialized);
- searching through the linked list from a node pointed to by the parent bucket pointer to locate a starting node for the bucket pointer (column 8, lines 16-20); and
- updating the bucket pointer to point to the starting node (column 8, lines 20-22).

Michael, applicants’ disclosed prior art, Rakity et al. and Schimmel are analogous art because they are from the same field of endeavor, namely linked list arrangement.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the initialization of bucket pointers of Schimmel with the hash table of Michael, the applicants’ disclosed prior art and Rakity et al.

The motivation for doing so would have been because “re-hashing of data records 156 in step 818 can take too long to be practical” (column 7, lines 39-41).

Therefore, it would have been obvious to a person of ordinary skill in the art to combine Schimmel with Michael, the applicants’ disclosed prior art and Rakity et al. for the benefit of a hash table that initializes new bucket pointers to obtain the invention as specified in claims 5, 19 and 33.

16. **Claims 6, 20 and 34** are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael (“High Performance Dynamic Lock-Free Hash Tables

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and List-Based Sets”) in view of applicants’ disclosed prior art as applied to claims 1-3, 15-17 and 29-31 above, and further in view of Hills (US 6,654,773).

17. **With respect to claims 6, 20 and 34**, Michael in view of the applicants’ disclosed prior art disclose the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 2, 16 and 30 (see above paragraph 10). Michael in view of the applicants’ disclosed prior art does not disclose the limitation wherein deleting the data node from the linked list involves using garbage collection or a solution to the repeat offender problem to reclaim the data node if possible.

However, Hills discloses the limitation wherein deleting the data node from the linked list involves using garbage collection or a solution to the repeat offender problem to reclaim the data node if possible (column 2, lines 30-48).

Michael, applicants’ disclosed prior art and Hills are analogous art because they are from the same field of endeavor, namely hash table design.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the garbage collection method of Hills with the hash table of Michael and the applicants’ disclosed prior art.

The motivation for doing so would have been because “efficient and deterministic garbage collection is achieved” using this particular method (column 2, lines 52-53).

Therefore, it would have been obvious to a person of ordinary skill in the art to combine the Hills with Michael and the applicants’ disclosed prior art for the

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benefit of a hash table that uses garbage collection to obtain the invention as specified in claims 6, 20 and 34.

18. **Claims 7, 21 and 35** are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael ("High Performance Dynamic Lock-Free Hash Tables and List-Based Sets") in view of applicants' disclosed prior art as applied to claims 1-3, 15-17 and 29-31 above, and further in view of Blaker et al. (US 2001/0042204).

19. **With respect to claims 7, 21 and 35**, Michael in view of the applicants' disclosed prior art disclose the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 1, 15 and 29 (see above paragraph 9). Michael in view of the applicants' disclosed prior art do not disclose the limitation further comprising generating the hash key by performing a pre-hashing operation to achieve a uniform distribution of hash keys over possible hash key values.

However, Blaker et al. disclose the limitation further comprising generating the hash key by performing a pre-hashing operation to achieve a uniform distribution of hash keys over possible hash key values [0066, lines 16-17].

Michael, applicants' disclosed prior art and Blaker et al. are analogous art because they are from the same field of endeavor, namely hash table design.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the generation of hash keys with a uniform distribution with the hash table of Michael and the applicants' disclosed prior art.

The motivation for doing so would have been because "if the hash keys which are generated have a random distribution within the data structure address space, then the lower the ratio of entries to table size, the smaller the probability of a 'cluster' of entries of a specific size being created" [0066, lines 7-11].

Therefore, it would have been obvious to a person of ordinary skill in the art to combine the Blaker et al. with Michael and the applicants' disclosed prior art for the benefit of a hash table that generates a uniform distribution of hash keys to obtain the invention as specified in claims 7, 21 and 35.

20. **Claims 8-13, 22-27 and 36-41** are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael ("High Performance Dynamic Lock-Free Hash Tables and List-Based Sets") in view of applicants' disclosed prior art as applied to claims 1-3, 15-17 and 29-30 above, and further in view of Schimmel (US 5,960,434).

21. **With respect to claims 8, 22 and 36**, Michael in view of the applicants' disclosed prior art disclose the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 1, 15 and 29 (see above paragraph 9). Michael in view of the applicants' disclosed prior art do not disclose the limitations wherein if the average number of data nodes in each bucket exceeds a maximum value, the method further comprises:

- increasing the number of buckets in the bucket array to form a larger bucket array; and
- using more bits from the hash key to perform lookups in the larger bucket array.

However, Schimmel discloses the limitations wherein if the average number of data nodes in each bucket exceeds a maximum value, the method further comprises:

- increasing the number of buckets in the bucket array to form a larger bucket array (column 2, lines 29-41); and
- using more bits from the hash key to perform lookups in the larger bucket array (column 5, lines 2-8 say that the hash keys are represented by the numbers in the individual data records in Figs. 1A and 1B, and the keys range from 0-15, which may be represented by four bits; Fig. 11 shows a table with more buckets including a hash key with a value of 28, which requires a fifth bit to be represented in binary).

Michael, applicants' disclosed prior art and Schimmel are analogous art because they are from the same field of endeavor, namely hash table design.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the dynamic addition of hash table buckets of Schimmel with the hash table of Michael and the applicants' disclosed prior art.

The motivation for doing so would have been because this system is able to "keep [the hash table structure] as compact as possible and to avoid long bucket links" (column 2, line 25-26).

Therefore, it would have been obvious to a person of ordinary skill in the art to combine Schimmel with Michael and the applicants' disclosed prior art for the benefit of a hash table that dynamically adds hash buckets onto itself to obtain the invention as specified in claims 8, 22 and 36.

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22. **With respect to claims 9, 23 and 37**, Michael in view of the applicants' disclosed prior art and Schimmel disclose the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 8, 22 and 36 (see above paragraph 21). Michael in view of the applicants' disclosed prior art do not disclose the limitation wherein buckets in the larger bucket array are initialized on-the-fly as they are referenced.

However, Schimmel discloses the limitation wherein buckets in the larger bucket array are initialized on-the-fly as they are referenced (column 7, lines 47-50; column 8, lines 9-22).

Michael, applicants' disclosed prior art and Schimmel are analogous art because they are from the same field of endeavor, namely hash table design.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the on-the-fly initialization of hash table buckets of Schimmel with the hash table of Michael and the applicants' disclosed prior art.

The motivation for doing so would have been because "re-hashing of data records 156 in step 818 can take too long to be practical" (column 7, lines 39-41).

Therefore, it would have been obvious to a person of ordinary skill in the art to combine Schimmel with Michael and the applicants' disclosed prior art for the benefit of a hash table that initializes new bucket arrays on-the-fly to obtain the invention as specified in claims 9, 23 and 37.

23. **With respect to claims 10, 24 and 38**, Michael in view of the applicants' disclosed prior art and Schimmel disclose the method (which can also be

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implemented in a computer-readable storage medium, or by an apparatus) of claims 8, 22 and 36 (see above paragraph 21). Michael in view of the applicants' disclosed prior art do not disclose the limitations wherein initializing a bucket pointer involves:

- obtaining a parent bucket pointer for the bucket pointer;
- searching through the linked list from a node pointed to by the parent bucket pointer to locate a starting node for the bucket pointer; and
- updating the bucket pointer to point to the starting node.

However, Schimmel discloses the limitations wherein initializing a bucket pointer involves:

- obtaining a parent bucket pointer for the bucket pointer (column 8, lines 11-16; "if a bucket... includes a logical back pointer," lines 13-14, indicate that the bucket pointer is being initialized);
- searching through the linked list from a node pointed to by the parent bucket pointer to locate a starting node for the bucket pointer (column 8, lines 16-20); and
- updating the bucket pointer to point to the starting node (column 8, lines 20-22).

Michael, applicants' disclosed prior art and Schimmel are analogous art because they are from the same field of endeavor, namely hash table design.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the initialization of bucket pointers on-the-fly of Schimmel with the hash table of Michael and the applicants' disclosed prior art.

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The motivation for doing so would have been because "re-hashing of data records 156 in step 818 can take too long to be practical" (column 7, lines 39-41).

Therefore, it would have been obvious to a person of ordinary skill in the art to combine Schimmel with Michael and the applicants' disclosed prior art for the benefit of a hash table that initializes new bucket pointers on-the-fly to obtain the invention as specified in claims 10, 24 and 38.

24. **With respect to claims 11, 25 and 39**, Michael in view of the applicants' disclosed prior art discloses the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 1, 15 and 29 (see above paragraph 9). Michael in view of the applicants' disclosed prior art do not disclose the limitations wherein, if there exists an old hash table, initializing a bucket pointer involves looking for a corresponding entry in the old hash table first, and if this fails:

- obtaining a parent bucket pointer for the bucket pointer;
- searching through the linked list from a node pointed to by the parent bucket pointer to locate a starting node for the bucket pointer; and
- updating the bucket pointer to point to the starting node.

However, Schimmel discloses the limitations wherein if there exists an old hash table, initializing a bucket pointer involves looking for a corresponding entry in the old hash table first (column 8, lines 13-14, if the bucket contains a regular pointer), and if this fails:

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- obtaining a parent bucket pointer for the bucket pointer (column 8, lines 11-16; "if a bucket... includes a logical back pointer," lines 13-14, indicate that the bucket pointer is being initialized);
- searching through the linked list from a node pointed to by the parent bucket pointer to locate a starting node for the bucket pointer (column 8, lines 16-20); and
- updating the bucket pointer to point to the starting node (column 8, lines 20-22).

Michael, applicants' disclosed prior art and Schimmel are analogous art because they are from the same field of endeavor, namely hash table design.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the initialization of bucket pointers on-the-fly of Schimmel with the hash table of Michael and the applicants' disclosed prior art.

The motivation for doing so would have been because "re-hashing of data records 156 in step 818 can take too long to be practical" (column 7, lines 39-41).

Therefore, it would have been obvious to a person of ordinary skill in the art to combine Schimmel with Michael and the applicants' disclosed prior art for the benefit of a hash table that initializes new bucket pointers on-the-fly to obtain the invention as specified in claims 11, 25 and 39.

25. **With respect to claims 12, 26 and 40**, Michael in view of the applicants' disclosed prior art discloses the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 8, 22 and 36

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(see above paragraph 9). Michael in view of the applicants' disclosed prior art do not disclose the limitations

- wherein the data nodes are stored in the linked list in bit-inverted hash key order; and
- wherein increasing the number of buckets in the bucket array involves mapping the existing bucket array into the top half of the larger bucket array.

However, Schimmel discloses the limitations

- wherein the data nodes are stored in the linked list in bit-inverted hash key order (in Figs. 1A, 3A, 4A and 4B, the nodes are stored in decreasing bit-inverted hash key order); and
- wherein increasing the number of buckets in the bucket array involves mapping the existing bucket array into the top half of the larger bucket array (Fig. 5A; column 7, lines 45-47, lines 57-64).

Michael, applicants' disclosed prior art and Schimmel are analogous art because they are from the same field of endeavor, namely hash table design.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the storing of data nodes in bit-inverted hash key order and the mapping of the existing bucket array into the top half of the larger bucket array of Schimmel with the hash table of Michael and the applicants' disclosed prior art.

The motivation for doing so would have been because "re-hashing of data records 156 in step 818 can take too long to be practical" (column 7, lines 39-41).

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Therefore, it would have been obvious to a person of ordinary skill in the art to combine Schimmel with Michael and the applicants' disclosed prior art for the benefit of a hash table that stores data nodes in bit-inverted hash key order and maps the existing bucket array into the top half of the larger bucket array to obtain the invention as specified in claims 12, 26 and 40.

26. **With respect to claims 13, 27 and 41**, Michael in view of the applicants' disclosed prior art discloses the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 8, 22 and 36 (see above paragraph 9). Michael in view of the applicants' disclosed prior art do not disclose the limitations

- wherein the data nodes are stored in the linked list in hash key order; and
- wherein increasing the number of buckets in the bucket array involves interleaving the bucket array into the larger bucket array.

However, Schimmel discloses the limitations

- wherein the data nodes are stored in the linked list in hash key order (Figs. 1A, 3A, 4A and 4B, where the hash keys are the numbers in each node); and
- wherein increasing the number of buckets in the bucket array involves interleaving the bucket array into the larger bucket array (as the data nodes are rehashed from Fig. 4A to Fig. 4B, they are interleaved among the old and new buckets).

Michael, applicants' disclosed prior art and Schimmel are analogous art because they are from the same field of endeavor, namely hash table design.

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At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the storing of nodes in hash key order and the interleaving of data nodes in the expanded buckets of Schimmel with the hash table of Michael and the applicants' disclosed prior art.

The motivation for doing so would have been because "only half of the data records need to be moved" after extending the number of buckets (column 7, lines 22-23).

Therefore, it would have been obvious to a person of ordinary skill in the art to combine Schimmel with Michael and the applicants' disclosed prior art for the benefit of a hash table that stores data nodes in hash key order and interleaves data nodes to obtain the invention as specified in claims 13, 27 and 41.

27. **Claims 14, 28 and 42** are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael ("High Performance Dynamic Lock-Free Hash Tables and List-Based Sets") in view of applicants' disclosed prior art as applied to claims 1-3 above, and further in view of Douccœur (US 6,067,547).

28. **With respect to claims 14, 28 and 42**, Michael in view of the applicants' disclosed prior art disclose the method (which can also be implemented in a computer-readable storage medium, or by an apparatus) of claims 2, 16 and 30 (see above paragraph 10). Michael in view of the applicants' disclosed prior art do not disclose the limitations wherein the method further comprises:

- reducing the number of buckets in the bucket array to form a smaller bucket array; and

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- using fewer bits from the hash key to perform lookups in the smaller bucket array.

However, Douccour discloses the limitations wherein the method further comprises:

- reducing the number of buckets in the bucket array to form a smaller bucket array (column 5, lines 24-32); and
- using fewer bits from the hash key to perform lookups in the smaller bucket array (column 17, lines 21-34; when searching through a list of nodes, if the node with x significant bits from the key is not found, then a node with $x+1$ significant bits of the key is searched for; when the number of hash buckets is reduced, the number of significant bits of the key used therefore changes from $x+1$ to x).

Michael, applicants' disclosed prior art and Douccour are analogous art because they are from the same field of endeavor, namely hash table design.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the dynamic subtraction of hash table buckets of Douccour with the hash table of Michael and the applicants' disclosed prior art.

The motivation for doing so would have been to "free memory for use by other applications" by reducing the amount of memory used by the hash table (column 5, lines 25-26).

Therefore, it would have been obvious to a person of ordinary skill in the art to combine the Douccour with Michael and the applicants' disclosed prior art

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for the benefit of a hash table that dynamically subtracts hash buckets from itself to obtain the invention as specified in claims 14, 28 and 42.

Conclusion

29. The prior art made of record and not relied upon is considered pertinent to applicants' disclosure.

- Michael (US 2004/0107227) teaches the system disclosed in Michael ("High Performance Dynamic Lock-Free Hash Tables and List-Based Sets");
- Shalev, Ori and Nir Shavit, "Split-Ordered Lists: Lock-Free Extensible Hash Tables," teaches a hash table similar to applicants'; and
- Harris, Timothy L., "A Pragmatic Implementation of Non-Blocking Linked-Lists," teaches a hash table similar to applicants'.

30. Any inquiry concerning this communication or earlier communications from the examiner should be directed to James R. Golden whose telephone number is 571-272-5628. The examiner can normally be reached on Monday-Friday, 8:30 AM - 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Donald Sparks can be reached on 571-272-4201. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

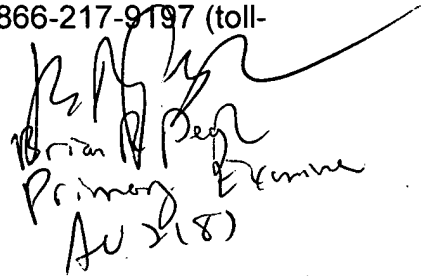
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James R. Golden
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Art Unit 2187



March 17, 2006



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